

DESIGN OF A MINE DEWATERING SYSTEM WHICH MINIMIZES CONSUMPTIVE USE OF A MAJOR GROUNDWATER RESOURCE

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INTRODUCTION

Competing demands on water resources are a natural consequence of population and industrial growth. Care must be taken, when utilizing groundwater resources, to minimize the adverse impacts on adjacent groundwater production wells. This paper describes one mining company's successful effort to reduce its groundwater withdrawal, yet increase the effectiveness of its mine dewatering system.

BACKGROUND

An open pit kaolin mine in Wilkinson County, just below the Fall Line, was reopened in late 1991. During the previous operation of the mine, J. M. Huber Corporation (Huber) discovered that the underlying artesian aquifer discharged groundwater into the mine pit through the exploration core holes which had been drilled through the kaolin clay stratum. Barge pumps were unable to effectively handle this water and the groundwater which drained into the pit from the sand stratum overlying the kaolin.

A groundwater withdrawal permit was obtained which allowed up to 7.5 million gallons per day to be withdrawn from the Cretaceous aquifer in the mine area. Four deep, high-capacity dewatering wells were subsequently utilized in the early 1980s to inhibit groundwater flow into the mine pits from the underlying Cretaceous aquifer. Each well was pumped at a rate of 1,000 to 1,500 gallons per minute. Total well depths ranged from 237 to 339 feet below ground surface. The average cost to install each well exceeded \$120,000 in today's dollars, and the electrical cost to operate the pumps was approximately \$5,000 per well per month. The theoretical radius of influence for the four well system was estimated by Huber's groundwater consultant to be in excess of ten miles.

Mining ceased in 1985, due to decreased demand for the type of kaolin being mined. Operation of the four wells ceased and the existing pit was allowed to fill with water. Demand for the kaolin from the mine increased in

1991. In response to this demand, Huber began pit dewatering at the mine utilizing barge pumps and one of the existing dewatering wells in November 1991. Thinking that there might be a more efficient way of dewatering the mine area, Huber retained a consultant, Golder Associates, Inc., in December 1991 to provide technical assistance with mine dewatering for the proposed pits.

METHODS

The dynamic state of the groundwater conditions due to ongoing dewatering efforts and the need to be mining kaolin at the earliest possible date precluded a detailed hydrogeologic investigation. The consultant suggested, and subsequently implemented, an approach to assess potential dewatering well designs in a manner that would immediately contribute to the mine dewatering effort.

The consultant reviewed information available from previous drilling at the site. Five piezometer pairs, located strategically around future pit locations, provided data necessary to assess the hydrogeologic characteristics of the aquifers above and below the kaolin clay stratum. A prototype dewatering well, screening the sand strata immediately above and below the kaolin, was constructed to test the effectiveness of wells for dewatering both of these aquifers. The new well and one of the existing dewatering wells were pumped in such a manner that would allow observation of the effectiveness of each well in dewatering the mine. Data gathered during this exercise were used to design a more effective and efficient system for dewatering the mined area than the older, high-capacity well system.

RESULTS

The investigation proved that a dewatering well system utilizing wells screening only the sand immediately beneath the kaolin clay stratum, instead of wells screening that sand and deeper sands, would be effective at augmenting pit dewatering with barge pumps. The system, because it minimizes the quantity of water pumped for dewatering, is

much less costly than the dewatering system previously employed. The reduction in pumping is the result of changing the approach from regional aquifer dewatering to aquifer depressurization directly beneath the mine. Because the aquifer does not need to be dewatered, mining may proceed almost immediately following the initiation of pumping.

By utilizing the geologic characteristics of the site and recognizing the dynamics of mine development, the current aquifer depressurization system, utilizing two to four wells producing approximately 250 gallons per minute each, is more effective than the previous system which produced in excess of 4,000 gallons per minute. The reduction in yield results in reductions in cost and impact on the surrounding aquifer system. Well installation costs have been reduced from approximately \$120,000 to approximately \$15,000, and electrical costs were reduced from approximately \$5,000 per well per month to approximately \$1,500. The radius of influence was reduced from approximately ten miles to approximately 3000 feet.

It was also determined during the investigation that wells were ineffective in controlling the groundwater in the sands above the kaolin stratum in a timely manner. The overburden groundwater is allowed to drain into the pits where barge pumps effectively handle this inflow.

CONCLUSIONS

An aquifer depressurization system employing up to four production wells pumping a total of less than 1,200 gallons per minute should be sufficient to keep water in future pits to a level than can be easily managed with barge pumps. As Huber drills its exploration boreholes to delineate the kaolin ore for future pits, information on the stratigraphy beneath the kaolin stratum is gathered and forwarded to the consultant. Piezometers are placed ahead of the pits to monitor water pressure beneath the kaolin stratum. The consultant maintains this information in a data base, along with hydrogeologic data gathered to date, so that future well placement can be optimized, based on projected pit coordinates, using a groundwater model. As mining progresses and pits are backfilled and reclaimed, existing wells which are no longer effective in reducing heads beneath the more distant pits are abandoned, and new wells are constructed so that the wells are installed only when they are needed and the geometry of the well system is most appropriate for effective hydraulic head reduction beneath the mined area. By working cooperatively with Huber's exploration geologists and mine operators, the consultant was able to design an efficient, cost-effective, and timely depressurization system which withdraws just enough water to enable Huber to mine the kaolin they need, when they need it.